BIOLOGICAL AND PHYSICAL RESEARCH ADVISORY COMMITTEE MEETING

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October 23–24, 2003

Minutes

Dr. Bradley Carpenter
Executive Secretary

Dr. Kenneth Baldwin
Chair

CONTENTS

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Welcome/Chair's Review of Agenda/Logistics—Dr. Kenneth Baldwin

Dr. Baldwin, Chair of the Biological and Physical Research Advisory Committee (BPRAC), called the meeting to order and welcomed participants, observing that many things are now in flux within the agency.

Office of Biological and Physical Research (OBPR) Program Overview—Ms. Mary Kicza

Ms. Kicza sees the dialogue and self-examination engendered by recent *Washington Post* articles as natural and healthy in NASA's quest to be sure space research is as safe as possible and to find ways to improve it.

A year ago NASA, through ReMaP, was revising its priorities in the strategic context of a 5-year budget for the Enterprise. Over the past year, personnel have been hired by simultaneously using a search committee and a competitive placement process. The result is a good team with all the needed skills to move forward. Accomplishments during the year include: devising a new research plan for the International Space Station (in response to Tom Young's task force) that proposes to stratify the level 1 requirements; establishing the position of ISS Program Scientist (Dr. Don Thomas now holds that position); and proposing the Human Research Initiative for FY2004.

The President's budget (with full-cost accounting) shows growth in the program due to the Human Research Initiative ($350 million), for both the biological and physical sciences components. The 2004 initiative follows the trend of acquiring a biological research knowledge base that will enable NASA to certify crew safety for missions beyond lower Earth orbit (LEO) for 100 or more days—in 2003, NASA proposed the Space Radiation Initiative (research to assure three 180-day missions for ISS crew members); and in 2001, the Bioastronautics Initiative. For the FY2005 budget, a prioritization process will be implemented.

The OBPR research plan, laid out in response to ReMaP, developed overarching questions that describe the goals of the program. These questions also provide a framework for the *Enterprise Strategy*, now at the printer and to be released in November. (It is now available at: <http://spaceresearch.nasa.gov/docs/OBPRStrategy.pdf>.)

Level 1, 2, and 3 management roles, responsibilities, and authorities have been established for OBPR, as have been the Enterprise Executive Council and Enterprise Program Management Council (EPMC). The Administrator has approved the ISS Research Capability (ISSRC) program commitment agreement and the program plan has been drafted. Of nine OBPR program executives recruited, six have been selected. The contract is in place for Enterprise Management Handbook and Configuration Management. There are two Deputy Assistant Administrators, one for programs, who interfaces with program executives, and one for science, who works closely with scientists to move program forward. The Research Partnership Centers program is undergoing realignment to meet NASA's strategic needs.

STS-107 research was very diverse and was supported by diverse organizations. About 30% of the expected data were retrieved. That report is available at: <http//spaceresearch.nasa.gov/research_projects/sts-107_highlight2.html>.

NASA has begun developing video briefings—"Benefits of Human Space Flight," which will be sent to Congress, and "NASA's Greatest Hits," which will go to every NASA employee and will be used in testimony. The CAIB report (led by Adm. Gehman) offers unanimous, strong

reaffirmation for human space flight. It also recommends establishing a long-range vision for NASA and instituting OBPR's self-assessment at Headquarters and field centers. NASA's ground program is unaffected by the CAIB report.

The ISS Research Institute (ISSRI) was chartered by NASA to engage the broader user community and provide ISS utilization and leadership. A draft Statement of Work was released September 9, 2003. The Development Team is now assessing and responding to comments. A draft RFP will soon be available for review.

The Space Station Utilization Reinvention (SSUR) team was established in January to identify strategies that would remove impediments to the utilization process. They identified 16 change strategies and presented the most important eight to the NASA Executive Council; their final report is currently under review. The eight recommended change strategies are:

- Emphasize the agency's focus on research.
- Make the PI the decision maker for research.
- Unify the Station and Shuttle utilization processes.
- Integrate utilization at JSC.
- Increase funding stability.
- Provide for alternate or supplemental space access.
- Reduce process complexity.
- Secure more mature proposals.

In sum, the leadership team, research plan, organizing questions, Enterprise strategy, and program management structure are in place. We're moving forward on ISSRI and improving that process with SSUR. OBPR is active in plans to return to flight and is communicating the benefits of human spaceflight.

Discussion

- The CAIB report will serve to encourage progress on recommendations in the SSUR report.
- The research community needs to be heard. The research NASA does is subject to external peer review; and in addition all of the research in space must require the microgravity environment.
- Research results demonstrate the benefits of space research daily. But, research is only one part of the debate. The benefits of human research are not just about the science—exploration is integral to human behavior.
- We have to communicate the excitement and the importance of space exploration. NASA says, "We have to explore"; members of the public say, "Why?" Most people have concerns they consider more immediate than space research (e.g., breast cancer), and these concerns will determine how those people respond to space research. Each committee member must be better educated to be able to respond to such comments. To address this need, NASA is developing informational products, e.g., the Message Book, the videos.
- One reason that justifies space research, but one many people don't want to hear is that we on Earth may need a get-away.
- The amount of money you have to spend to get to the spin-offs indicates that we should first determine the spin-off we want.

BPRAC Recommendations and Subcommittee Structure—Dr. Bradley Carpenter

Through telecons and meetings, Dr. Carpenter has been collecting recommendations since February. BPRAC members strongly recommend continuance of the Space Station Utilization Advisory Subcommittee (SSUAS), at least through the establishment of the International Space

Station Research Institute (ISSRI). Two principal structures for subcommittee organization are apparent, but there's no clear consensus on which is better. The current structure, the management image, is division-focused and complicates strategy development. Here, the subcommittee provides oversight and an advisory relationship to the program division. The management focus can be found in the commercial, life sciences, physical sciences, and space sciences subcommittees. The alternative, the strategy image, is theme-focused and effectively supports strategy development but complicates the relationship with program divisions. This structure entails primary functions through the subcommittees, and secondary functions through ad hoc task forces. Subcommittees would be responsible for developing 3-year strategies to achieve NASA's mission. For each of OBPR's organizing questions, activities have been identified for the time frames 2004–2008 and 2009–2016. Existing models are: Space Science Advisory Committee (which has four subcommittees); Earth System Science and Applications Committee (two subcommittees); and Aerospace Technology Advisory Committee (six subcommittees).

Discussion

- To retain the SSUAS, we need to re-charter the subcommittee and appoint a new chair and executive secretary and reconsider the membership. SSUAS is a cross-cutting subcommittee whose concerns go well beyond OBPR, and should relate and bring in the flavor and concerns of other codes, but not major policy issues of other codes. Through SSUAS, BPRAC members have learned about problems in other areas, but, ultimately, OBPR is powerless to do anything about those problems. Other advisory committees (within the existing structure) do not cut across enterprises. Maybe SSUAS requires special attention. Or, this situation could reflect a fundamental difficulty with NASA's structure regarding ISS matters. Members of SSUAS feel they have no voice—they report to BPRAC and BRPAC reports to others—but perhaps SSUAS should report directly to NAC. The common conclusion is that we need to make SSUAS a successful subcommittee. [Dr. Carpenter will take part in re-chartering the subcommittee to define communication channels.]
- Communications problems occur predominantly between engineers making the equipment and scientists doing the research. But, this is a fundamental issue in NASA management, and one OBPR can't resolve. The current lack of a unified management structure may not be in NASA's best interest, but the Enterprise infrastructure at the AA level is coming together.
- We need crosscutting, ad hoc subcommittees. Changing from "column-dominated" to "row-dominated" subcommittees would be revolutionary reorganization. Now we have subcommittees that supplement their expertise with task forces, but task forces at the BPRAC level might be helpful. The current structure has been very "stove-piped," with members advocating for their own areas ("we vs they"), so it has not served well in the past. It leverages experience and advocacy for a particular area because the subcommittee structure becomes dominated by the principal investigators in the program, a built-in conflict of interest. The strategic community-based focus tries to serve the enterprise as a whole. Dr. Lomax is one division director who finds value in the current structure, although subcommittee members have been underutilized in the past.

- In the alternate model, structure at a division level could be retained while focusing with question-specific task forces; it would function to stop the "stove-piping" throughout Each member of BPRAC is also a member of a crosscutting subcommittee. BPRAC is the integrator and needs more fluidity than it's had. Task forces can come and go and their composition can be more easily changed, and strategy groups formed when needed. It would allow for a much larger BPRAC membership although BPRAC would still need some experienced members, either from BPRAC or subcommittee alumni, who know the structure, acronyms, etc.

International Space Station Research—Dr. Don Thomas

Until NASA returns to flight, all shuttles are grounded. Transportation to and from the Space Shuttle is limited to Progress and Soyuz for upmass, and to Soyuz for extremely limited downmass. ISS crew size was reduced from three to two, which means less crew time and fewer subjects available for investigations. (E.g., 12 Progress launched in August with 15 kg of upmass for science; 7 Soyuz launched October 18 with 16 kg of upmass.) Research goals are to:

- Complete experiments begun before the Columbia accident,
- Perform additional experiments on reusable samples,
- Develop new, small experiments to fly on Progress vehicles,
- Develop new experiments requiring minimal upmass, and
- Maximize international cooperation—examples include Granada Crystallization Facility (Granada University/ESA-developed), NASDA- (now JAXA-) sponsored research, Russian launch vehicle, stored in U.S. cooler on ISS; hand posture analyzer to study the effects of bone and muscle loss in the hand during long flight—Italian-sponsored expedition, launched on 12 Progress as part of the U.S. allotment, to be performed by Increments 7 and 8.

ISS near-term utilization is limited by Progress and Soyuz resupply flight opportunities. Recently, 22 payload candidates were identified for 13 Progress (totaling some 100 kg). (The 13 Progress launch, scheduled for November 20, 2003, may slip to January.)

Return to flight will occur no earlier than September 12, 2004. All Shuttle flights will lose 1026 lb of upmass. ISS altitude will be reduced by 15 miles for LF1, ULF1.1, 12A, 12A.1 (which leads to a 1500-lb performance gain). Currently, 7 research racks are on orbit, 70 investigations have been completed or are underway, 6 additional racks are ready to launch, 4 express transportation racks have been completed, and 7 additional research facilities are under development. Peggy Woodson was designated Science Officer for Expedition 5.

On Expedition 6, completed last May, two problems arose. An ARCTIC freezer and the Microgravity Sciences Glovebox failed. Both were repaired—demonstrating what a crew member on board can do—and neither had to be brought back down for repair. Meanwhile, 14 investigations were completed, and 8 were partially completed or deferred.

Expedition 7, which was to launch on the next flight after Columbia, is essentially done. The glovebox has been used extensively and several experiments were completed. Ultrasound equipment (HRF) is being used to develop a telemedicine capability, and six human life science investigations have been completed (bone, biopsy, midodrine, chromosome, interactions, and hand posture analyzer). Cellular biology (CBOSS) fluid dynamics tests of facilities for growing tissue were performed and five science education demonstrations have been completed.

Work continues to prepare for Expedition 8, including, e.g., ESTER (Earth imaging) and ISSI (soldering). The "Cervantes" Soyuz Taxi Flight launched last week with a Spanish astronaut and several life science, two physical science, and a few education projects. Some experiments planned are reusing samples from Expedition 7. The next upmass launch will be critical to some of them.

Through research prioritization the most important projects will be identified and flown first. The criteria are: strategic value, scientific return, terrestrial application, timely research, readiness for flight, vehicle resources required, platform, and other factors. The prioritization method was first tested a few weeks ago with 25 investigations from Increment 10. Each team member gave

evaluations in writing, and a report including results and recommendations for action is being prepared.

Discussion

- The decision to use this type of ultrasound machine on orbit was part of HRF1 at least 2 years ago. The technology is useful at DARPA and DoD for the battlefield.
- The Earth observation opportunities the Space Shuttle affords are not available from commercial satellites. For example, Ed Lu took from the Shuttle all the photos that were televised and published of Hurricane Isabel.

Lunch presentation by Dr. Alex McPherson

Crystal growth experiments in space.

ISS Research Institute—Ms. Betsy Park

In February 2003, Congress authorized NASA to establish an NGO for ISS research. The Statement of Work was published for comment in September 2003. In February BPRAC recommended:

> NASA still needs to articulate more clearly the division of research management between OBPR and the proposed ISS–NGO as well as with other research institutes involved with OBPR The manner in which NASA Headquarters intends to handle the NRA and grant selection processes for ground-based and flight research is a particular concern.

The proposed division of responsibilities is to work with the community to develop a roadmap, and to work with NASA, advisory committees, and their consultants to pull together a final plan and roadmap. Each Enterprise develops its own station-specific roadmap for 3-, 5-, and 10-year time frames.

ISSRI provides "front door" (help desk, information sources) for potential users; NASA provides customer support for principal investigators from selection through post-mission via the Project Scientist, Project Manager, and Payload Integration Manager. One group should bring back integrated customer feedback on a regular basis. A contractor does this today, but NASA is looking for an institute to do it in the future.

For research partnerships (that is, government/commercial partnerships), a Merit Evaluation Board would be formed to review all commercial research on ISS; ISSRI would develop selection recommendations; NASA would select commercial research through its prioritization process, which would serves as a peer review process for commercial endeavors. Research prioritization works as follows: ISSRI manages the new prioritization process; external independent boards score the projects; the ISS Program Scientist has oversight of the process; ISSRI assesses alignment of a prioritized list of projects with NASA's strategic objectives; EPMC works for NASA, headed by Mary Kicza. Meanwhile, the structure of the Research Partnership Center (RPC) will not change. One of its biggest challenges has been access to space, which the board can't fix. An independent body would be assigned to determine, in light of developing market trends, the value of a project.

The Office of Education and Public Affairs wants to create a consolidated, cohesive program that focuses on the national level instead of the local level. Research programs will also be using archived data and samples; commercial data files are not now being optimally used. ISSRI will develop educational outreach and public outreach at a national level. NASA wants responsibility

for the strategic direction of education, and will review products before they are released to the public.

The concept of the guest investigator (GI) program—modeled on the Hubble Space Telescope Program—has been reintroduced. ISSRI, not NASA, will be responsible from start to finish. The Institute would select the investigators and the projects. ISSRI would manage specific flight hardware and the research conducted with it, archived data and samples, and commercial hardware. NASA would complete initial primary objectives and work with the Institute. For GIs and principal investigators (PIs), solicitation and selection rules are reversed: For PIs, OBPR, as the process owner, develops and approves NRAs, contracts with NPRS to manage logistics, selects panels and monitors peer panels, partners with ISSRI to develop recommendations, develops and presents final recommendations to the selecting official, and (through SSO) makes the final selections. ISSRI collects community input, provides recommendations for research content, recommends panel members, monitors peer panels with OBPR, and partners with OBPR to develop recommendations. However, for GIs, OBPR recommends research content, recommends panel members, monitors peer panels with ISSRI, and partners with ISSRI to develop recommendations. ISSRI, as the process owner, develops and approves ISSRI research announcements, selects panels, monitors peer panels, partners with OBPR to develop recommendations, develops and presents final recommendations to ISSRI selecting official, and makes final selections. Contract length (5 years, 10 years, etc.) is still under discussion, as is the possibility of phasing work in over the first 3 years and then building up.

Comments to the SOW are now under review and results will be posted on the Web. So far, the three most common concerns are: potential conflict of interest, source of funding, and lack of international interfaces. A draft request for proposal (RFP) will be released for public comment in December or January, industry will be briefed in January or February 2004, and a contract will begin by December 2004.

Archive management involves a task order for each archive NASA wants ISSRI to manage. The intent is to have ISSRI manage OBPR ISS research archives, starting with physical sciences; biological sciences are undergoing policy review. The archive should exist in perpetuity, but the details depend on what NASA intends to do with the archive. (Currently, a contractor handles LSDA, but NASA owns it.)

Discussion

- There is no difference between this Institute and any other institute, and the SOW does not require any specific form of relationship between ISSRI and other institutes. Bidders can form a relationship with any other institute as appropriate. Institutes are encouraged, but not required, to work together.
- There seems to be a built-in conflict of interest in turning review over to the people who are competing for grants—these individuals have a programmatic stake in an outcome that will determine which project becomes part of a payload. However, because the board will be staffed by people with no programmatic investment, it is analogous to the peer review process but for commercial projects. NASA is also trying to bring all commercial factors into this mechanism and to strengthen the scientific value of research in space.
- There are no set-aside resources for GIs; they are evaluated with everyone else. It may seem to be an erosion of NASA's role, but it parallels the Hubble Space Telescope program. The Institute must determine what the various roles are. The NGO's money comes from the hardware owner. (At first this will most often be OBPR.) If the hardware comes from OBPR, OBPR pays for additional use. People have a charge to see if an instrument can produce more; but conflict of interest and quality control are likely problems. Scientists in space science are a cohesive group and facility-oriented, whereas OBPR is very diverse and may

not be able to function as a cohesive group. The ISLSWG agreement assigns hardware either to the Shuttle or to the PI, and it cannot be used for another purpose.

- GIs and PIs have no priority difference: GIs (both project scientists and project managers) work for the Institute and needs a new order for each flight; PIs work for NASA. What distinguishes GIs from PIs is the hardware they use. If the Institute has no further use for hardware, it offers it to a GI for a new experiment. NASA is looking to the Institute to help get more use out of hardware, which cannot be done with the current PIs. NASA could solicit GIs, but with this plan they will compete for payload manifest via prioritization. Because the process is not managed by Headquarters, it may represent a reduction in quality of evaluation. For several years, the CAS has raised the issue of cost of hardware, which is sometimes more expensive at NASA by a factor of 10. But this estimate doesn't address the initial cost of hardware or the cost of maintaining it.
- ISSRI is not funded from new program funds. In the October 1999 draft for the NGO reference model, the primary goal was to reduce the cost, but now that is no longer the case.

NASA Budget Perspective—Mr. Doug Comstock [for Mr. Isakowitz]

The budget office is now drafting the FY2005 budget in the national context of top priority for terrorism, homeland security, and military spending. Controlling discretionary spending will be of foremost concern. Last year, when the budget process operated under many similar pressures, NASA's budget increased more than that of other agencies. ReMaP was undertaken and priorities set, and a new strategic plan released; then Columbia happened 2 days before the budget was released. Now we have to understand how we'll return to flight, and the budget implications of that. Another aspect is the heightened awareness and interest in human space flight and whether we understand the risks to humans and can mitigate those risks.

Discussion

- The Columbia accident implies an additional cost for a $2 billion orbiter plus the cost of repairs. Some of the money needed to make up the increased expenses will come from research not done because the Space Shuttle was put "on hold."
- Full-cost accounting makes NASA's slightly increased budget appear to be greatly increased. The 2004 budget will soon pass Congress in some form—the following budgets are best guesses—and if the 2004 budget is insufficient, modest growth above it will not help.
- Full-cost accounting would seem to give more flexibility, which was the intent. The recipient has to pay for expenses, but the accounting system came with more money to enable that.
- Research partnerships and the flight support theme constitute an unfair combination because it hides a serious problem. The budget appears to be growing, but next year the Research Partnership Program will be all but dead. The flight support theme is really supporting the other two lines.
- A tremendous riptide is taking place here, which supercedes the Research Partnership Program. The discussion and decision process have gone to some committees on the Hill. The decision won't be an administration decree; the NSC process and other agencies will be involved.
- The Budget Office didn't want a proliferation of small themes to be managed at the agency level; the trajectory of the RTT budget has been thoroughly analyzed and highlighted for OMB. The general policy of the White House is that government shouldn't be funding commercial projects.
- One complication is that the President sends a 5-year budget to Congress, but Congress acts only one year at a time.
- The OBPR budget began with a chain of events: Space Station overruns (Young report); priorities were addressed (ReMaP); the Human Research Initiative came to the forefront (two

task force reports). Today, the Columbia disaster has generated much internal discussion within NASA and the White House.

- NASA has been through two budgets with full-cost accounting. Implementing it at first will be a struggle, but the process will uncover previously hidden activities and aspects. Full-cost accounting will drive out areas of inefficiency, which will free up money for other projects. Difficult decisions will come with regard to programs that run at a loss for a time. However, full-cost accounting is a business model without benefit of all the business tools.

DIVISION DIRECTORS' REPORTS

Mission Integration—Mr. Peter Ahlf

Throughout the year, Mission Integration has: supported the SSUR team, aided in ISS research near-term planning and re-planning, begun ISSRI procurement activities, drafted the ISS Research Capability (ISSRC) program plan, put in place the OBPR process for certification of flight readiness as well as the contract to develop the Program Management Handbook, completed the ISSRC Program Commitment Agreement, and initiated the ISSRC program plan and development of the OBPR Management Handbook.

ISS research planning for return to flight begins with fixing problems that caused the Columbia disaster. In addition, spacecraft must be launched in daylight hours so the launch can be photographed. NASA must be able to support on-orbit development and repair, which means that a substantial amount of equipment will have to be carried up. These considerations dictate the timing of the next launch. Among the ISS requirements identified was the need for a crew larger than three, and the plan has been updated accordingly. The free-flyer study indicates that a series of OBPR robotic spacecraft launches could be feasible as early as 2009; a workshop is planned for December to devise a strategic roadmap.

ISS payload processes are continuously being improved. The Integrated Space Transportation Plan is considering: linking ISS research requirements to the Enterprise strategy; expendable vehicle systems to support research cargo requirements (the Alternate Access to Station study; adding research requirements (the Orbital Space Plane); and the X-37 Advanced Technology Demonstrator, part of OSP, for which demonstration missions are planned in 2004–2007. Missions of 2 to 270 days are being planned with 500-lb payloads and 400-watt average power and heat rejection. The Multi-User Support System (MUSS) has achieved significant accomplishments. The ISS down-link enhancement architecture will save $1 million per year because NASA will not have to lease commercial satellites. Space Life Sciences Lab—providing aquatic labs, experiment support labs, animal care, and plant research facilities—will be inaugurated by December 2003.

Mission Integration is also developing thermal conditioning requirements. A cold-stowage workshop was convened in October and a schedule was proposed for hardware development. The ISS payloads Office process improvement goals focus here on customer satisfaction for which they sent out a survey for Increments 5 and 6.

Discussion

- Mission Integration seems most closely linked to SSUAS, and the advice they get from SSUAS is important. Mr. Ahlf believes Mission Integration should be making more use of this resource and wants to be sure we maintain that type of dialogue.

Space Product Development—Dr. Frank Schowengerdt

FY2002 accomplishments included: 15 Research Partnership Centers, 157 industrial partners, 288 publications (188 refereed), 75 graduate and 40 undergraduate degrees awarded, a $97.6 million total cash and in-kind program leveraged off $29.3 million in SPD funding, 8 payloads of partnered Shuttle and ISS research, and cost-effective development of hardware. Payloads on orbit on ISS include: the Commercial Generic Bioprocessing Apparatus (CGBA), Zeolite crystal growth (ZCG) (inactive and awaiting samples), and the Advanced ASTROCULTURE Support System. Payloads scheduled include space-DRUMS (which are on dock at KSC), BioServe, MERLIN, and completed testing of the Commercial Protein Crystal Growth-Liquid Diffusion prototype flight growth chips. Experiments on STS-107 included: ASTROCULTURE Commercial Plant Growth Chamber, water mist fire suppression system (MIST)—of interest to the Army, Navy, and Coast Guard—protein and zeolite crystal growths, and ITA biomedical experiments. They received 90% of the data from MIST, which met all goals, namely to determine the optimum droplet size to maximize fire control efficiency. To do this required a regime where results are independent on droplet size, which is not observable at 1 g.

In a major breakthrough, Auburn University's Solidification Design Center (SDC) cast the first-ever magnesium component using the Vacuum Sealed Molding Process. A university/industry/government consortium will become an NIH Center of Excellence for Biological Threats. Another initiative is HDMAX (high definition digital TV). Proposals include investigating: materials for protecting thin-film solar cells and the stretched lens from atomic oxygen and UV radiation in space; a propulsion system based on the catalytic breakdown of N_2O; and surface rocks and subsurface boreholes to reduce data bandwidth demand. The status of the ExPRESS pallet, and return to flight and access to ISS are of particular concern. However, all progress is totally overshadowed by the budget issues. The proposed budget for FY2005 cuts SPD's budget by two-thirds. The impact on utilization of ISS and STS mid-deck lockers will be significant because, without SPD, the Shuttle will fly to the Space Station half empty.

SPD is trying to realign the program to more directly serve NASA's mission. They are beginning to implement the 2003 Development Plan submitted to OBPR in July. The President's management agenda states that "Federal R&D should not compete with or supplant private investments." RPCs don't do commercialization. Faculty and students in the RPCs do research with their industry partners; the partners do the commercialization. Partners choose to work with the RPCs to leverage their capabilities and resources. In the process, NASA leverages its own funds by factors of 2 or more.

OMB/OSTP guidelines require programs and projects to justify their appropriateness; and the Commercial Space Act of 1997 requires that the priority goal of ISS be the economic development of Earth orbital space. SPD is the only program that does this. SPD has been continually reviewed and refreshed since it began in the 1980s. SPD's results and products are directly relevant to all five of OBPR's organizing questions by: aiding in the survival of humans traveling far from Earth; showing how life responds to gravity and the space environment; bringing new opportunities to expand our understanding of the laws of nature and enrichment of life on Earth; creating technology to enable the next explorers to go beyond where we have been; and educating and inspiring the next generation to take the journey. Most projects are strategic and commercial. SPD plans to refresh the program as they realign it in the process of closing at least two RPCs in 2005 and starting a new one. But, this in not a linear process: if government funding disappears, so will the industry partners.

In sum, SPD is at a crossroads. It has a legacy of accomplishment in moving everyday business into space to benefit society. It has now been directed to shift its focus toward NASA's purposes, which presents no fundamental conflict—each role can enrich the other. Where they intersect

there are new opportunities and SPD will become even more valuable to OBPR, NASA, and the nation in the years to come.

Discussion

- SPD is now looking at initiatives with other programs and developing white papers.
- SPD needs some kind of subcommittee group and also needs input into the larger BPRAC structure—everything they do in SPD is interdisciplinary.
- The industry/government ratio has increased; now it's 170, whereas it had been around 120.
- Partners can produce hardware so much cheaper than NASA because in universities they're used to doing things on a shoestring with graduate student labor.

Physical Sciences Research—Dr. Eugene Trinh

The Physical Sciences Research Division has added four people and continues to work with the program officers of the five NASA centers. Work on some dozen projects on ISS Increment 7 (April–October 2003 with astronauts Malenchenko and Lu) ranged from microgravity acceleration to crystal growth to biotechnology to soldering to pore formation. For Increment 8, a number of small additional investigations are scheduled, depending on the availability of space and crew time.

InSPACE investigates the structure of paramagnetic aggregates from colloidal emulsions. Its objective is to determine the true three-dimensional, low-energy structure of magneto-rheological fluids in a periodically interrupted magnetic field. The benefits include validating models of equilibrium suspension structures. It is also relevant to MR fluid applications, which require that the fluid respond reproducibly to an external field that is repeatedly being switched on and off. Pore formation and mobility investigation promotes understanding of detrimental pore formation during controlled directional solidification processing in a microgravity environment. Other OBPR research included on STS-107 was Sofball-2, which showed that flame balls drift to the wall through an as-yet-unexplained mechanism.

Ground-based research projects—e.g., hemoglobin C crystal and insulin crystal growth, smectic liquid crystals, gas phase polymerization and nucleation in microgravity, and structure in dense colloidal gels—were published in and featured on the cover of various peer-reviewed journals (*Science, Physical Review Letters, Chemical Processing, Langmuir, Journal of Structural Biology,* and *Physics Today*). Principal investigators also received awards and honors for their OBPR research, and OBPR continues to collaborate with other organizations, e.g., NSF, Air Force, and Advanced Bionics, Inc.

The Bio-Science and Engineering Program is a new cross-disciplinary, cross-center program that applies newly discovered atomic- and molecular-scale methods and the theoretical understanding of complex systems to target the molecular processes involved in living systems relevant to human space flight. The flight program for macromolecular biotechnology (protein crystallization) is to continue, pending return to flight, and is projected to phase out in 2008. However, there's no NRA funding for protein crystallization because NRA 2002 biotechnology has been cancelled. Cellular biotechnology is back on a yearly schedule for NRA 2003 and will be coordinated with Fundamental Biology for a joint NRA in FY2004.

The OBPR program is responding to the organizing questions: Strategic Research for Exploration addresses #4 and #1, and Fundamental and Applied Research addresses #2 and #3.

Discussion

- Physical Sciences is leaning toward the second BPRAC model for subcommittees (task forces).
- Physical Sciences will finish the fundamental research associated with protein crystallization, but will have no more protein crystallization projects. Nevertheless, the Physical Sciences Research Division has participated in 45 flights so far and has had substantial results. In its report on Biotechnology research planned for the ISS, the NRC said NASA should focus its work in protein crystal growth on biological structures that represent really major advances, ones that would be Nobel Prize material; that is an ambitious target for any program.

Bioastronautics Research—Dr. Charles Barnes

Bioastronautics is composed of: Biomedical Research and Countermeasures, Advanced Human Support Technology, and International Space Station Research Capability. Three new positions have been filled.

Of OBPR's organizing questions, Bioastronautics Research is most involved with #1 and 4. About six NRAs are out now—including the International Long-term Bed Rest study, which complements the previous study; and radiation research—and numerous collaborative activities are underway. They are revising the critical path roadmap, which will undergo external review in spring 2004. Meanwhile, Bioastronautics continues to develop plans for getting a Sabatier reactor on ISS, and tries to make sure that they're doing things the operations side needs.

Equivalent System Mass—Dr. Ed Smylie

Equivalent System Mass (ESM) is the computation of the sum of inputs to describe the system impact in terms of a single parameter, mass. Conversion factors are derived from data on infrastructure technologies and environments. The metric compares the ESM of current technology to the ESM of advanced technology (ESM_{ISS}/ESM_{ALS}). It populates factors with existing technology; then populates them with the best guess of future technology and divides the two. But, because forecast events won't be realized for 20 or 30 years, errors in assumptions are likely. The computation is limited to things that have reached a level of certainty of which you can be fairly confident.

Congress mandated that federal agencies measure their progress annually. To comply with the mandate, in 2001 they made ESM computations on an Excel spreadsheet; in 2002 they used a 2002 baseline document and a new computer program; and in 2003 the baseline assumptions stayed the same, but they went from version 2 to version 3. (See <www.advlifesupport.jsc.nasa.gov>.) The Reference Mission is an ISS upgrade—either the ISS following assembly completion, or a new facility of similar size and capabilities. Independent exploration targets a 960-day mission to Mars, using three vehicles—the Mars transit vehicle, the Mars Descent/ascent Lander, and the Surface Habit Lander. In the future, more data will be verified; they will integrate advanced life support sizing analysis tools with the advanced life support database; they will account for crew time in ALSSAT and add additional technologies to it; and they will consider more flight-like configurations.

Discussion

- LSAS has been very important to Bioastronautics Research, and they want the same or a similar body to continue.
- Computations with assigned risks and wide error bands give strange results.
- The metrics statement must be rewritten.

Fundamental Space Biology—Dr. Terri Lomax

Fundamental Space Biology will increase its liaisons with Code U and the National Institutes of Health. FSB will receive $28 million over 5 years; some 80% of its program content is in ground research, with the remainder in flight research. Included are the Radiation Health Initiative, Early ISS Cell and Molecular Science, and technology development for in situ biology and telemetry. (FSB must stop relying on sample return—they will be lucky to get 20% returned from SST-107.)

The core of the Space Station Biological Research Project (SSBRP) has been funded. ISS reserves have been established with 20% for hardware development and 10% for utilization. The insect habitat is being built by Canadians; the centrifuge and the life sciences glovebox by the Japanese (who have undergone budget problems and agency re-forming). Post-ReMaP, habitat for animal and plant research was restored. Habitats are being designed to get them up as quickly as possible, but with enough flexibility to incorporate improvements as they become available. It's not cost effective to build a specific habitat for each species, so FSB concentrates on models that can be adapted, e.g., *C. elegans*, *Arabadopsis*, and *Drosophila* For example, the ExPRESS rack and the plant habitat have been adapted to accommodate *Drosophila.* This is being done in a phased way because full funding was not reinstated. With this phased approach, cellular and molecular research has been moved forward because it can be done at this point. FSB is also doing genomics and proteomics because that will yield large amounts of data that many people can use.

Two experiments were found in wreckage of the STS 107. The moss experiment in BRIC hardware yielded 40% of the expected data, which confirmed what had been seen on orbit, namely the underlying growth pattern in the absence of light and gravity—a spiral of protonema, whose center spot had been mounted before flight. At the last moment (using existing hardware, they got it approved and in space in 17 days), *C. elegans* in growth medium in a BRIC was included on the flight. In the end, 40 to 50% of the data were collected—*C. elegans* was still alive after reentry and two months on the shelf. This test of the medium shows that the culture will survive a long time in adverse circumstances.

The French invited NASA to do a taxi mission (i.e., ride up and back) in April. REMORA (named for the hitchhiker fish that accompany sharks) experiments offer an opportunity to share specimens and hardware. Using targeted NRAs, they avoid resource roadblocks. For efficiency and effectiveness many small payloads are desirable. FSB has no hardware in space, so they adapted experiments by using lyophilized cells and commercial hardware (rather than ADSEP) on orbit, and the Progress for transportation.

The cell culture unit design is 90% complete, and JAXA has delivered the life sciences glovebox procedure development unit. Equipment has been engineered to fly up, test, fly back, tweak, and use. However, it is more cost effective to design hardware to stay on orbit, rather than to fly it back and forth. FSB is working on a bio-specimen sharing plan that would give many researchers access to specimens. (This is a response to people who want archived rodent tissues.)

Other considerations for hardware are acoustics and temperature uniformity, which are becoming increasingly important because the crew has been experiencing hearing loss. In addition, every Shuttle flight includes a boom so repairs can be done, which takes a lot of mass, power, and time.

To more fairly represent the disciplines of evolutionary biology and gravitational ecology, FSB requested a blue ribbon review, chaired by Michael Novacek (director of the American Museum of Natural History). The resulting report is available at:

<http://fundamentalbiology.arc.nasa.gov/EP/reports/NOVACEK_COM_REPT.doc>. FSB is working with Astrobiology (Code S), which mainly focuses on geology and contains remarkably little biology. (FSB should own biology for Astrobiology.) The National Science Foundation (NSF) would like to extend its Microbial Observatory to ISS, so FSB is starting a new collaboration with NSF to do this. A joint Cell Sciences and Genomics Council was formed to coordinate all of OBPR cell biology research and hardware. (The American Society for Cell Biology had criticized NASA's cell research, but that attitude has now reversed.) They are also trying to educate investigators about what you need to know to do cell biology in space.

FSB revitalized collaboration with the Russian Institute for Biomedical Problems. They're working with Code AM, a JSC crew officer, and the ISS Tiger Team to design microbial sampling for the observatory and also to design archival sampling to work along with the crew-health sampling to enhance medical operations while collecting fundamental data. They're reviewing the Critical Path Roadmap with CHMO and Bioastronautics, and they are working with Bioastronautics to review all plant biology programs in December. (Dr. Lomax would like to see that published.)

To schedule the FSB flight queue, they reviewed science objectives, aligned them with the overall strategy, got peer review critiques, and reviewed implementation options regardless of experiment maturity. Of the total, 11 would have a current implementation plan for the Shuttle or ISS. An example is ISGEN (In situ Space Genetics Experiments on Nanosatellites), a 24-month project to develop 10- to 20-kg nanosatellites, which addresses the need to return on-orbit data. A set of reference experiments has been conducted on yeast, *Drosophila*, etc. They are now working with students who are launching weather balloons, which fly up to 80,000 ft; the balloon bursts; and the box enters a 30- to 60-second free fall before its parachute opens and the box lands in a cornfield in Iowa. Images have been retrieved of *C. elegans* during the free-fall. (Technological development is much quicker when humans are not the subjects.) The project also has good educational potential, and the boxes can go as secondary payloads on any launch.

Issues FSB must contend with are that their 2001 budget was reduced by 69%, and FSB needs to find a way to restore this. Rodent and plant habitats have been restored, but with significantly reduced capabilities. Lab support equipment was eliminated, and the utilization budget is insufficient to support full use of FSB facilities. In addition, access to flight will be very limited after return to flight.

Discussion

- FSB has addressed budget deficiencies creatively.

Consensus on Critical Issues on which OBPR Needs Feedback

- The SSUAS committee should be continued; the question is its leadership and membership.
- BPRAC should use its own ingenuity as to how subcommittees should be constructed and should list attributes that are needed. [Dr. Harris and Dr. Borer will draft something on subcommittee restructuring, which will include pros and cons.]
- Committee members are assigned to think about fundamental questions that need to be addressed regarding the ISS Research Institute so the program will move forward in the best way. BPRAC members need to talk to Mary Kicza and may have to put the issue to a BPRAC subcommittee, but first we need to define a series of substantive questions. Only BPRAC members who will not be part of a bidder package can be involved in this exercise. A telecon might be appropriate to facilitate dialogue with Mary, or this issue may be important enough that Code U will convene another meeting.

- The proposed NGO process is alarming in having a Guest Investigator (GI) do what a Principal Investigator (PI) should. An NGO should not manage the GI, should not be involved in peer review process, and should not run independent research in their own organization. They should manage research on ISS, not try to do their own, as well. GIs seem to be people who compete to use NASA equipment that has not been fully utilized; then their project is prioritized in the totality of what OBPR is doing. Whether they get funded depends on NASA's prioritization. BPRAC should recommend that this go to a task force. We need something like an action plan for the ISSRI, but what issues should we address?

Adjourn 6:15 PM

Friday, October 24

NASA's Plans for Return to Flight—Ms. Lynn Cline

Some 38% (by weight) of the Columbia has been recovered and is in storage (84,900 lb). Volume I of the accident report was released August 26. It contained 29 recommendations (15 relating to return to flight, and 14 long-term), 138 findings, and 27 observations. Its focus was on culture and organization, requirements to return to flight, and technical excellence. The Space Station crew is restricted to two, the assembly is on hold, NASA is dependent on partnerships (namely the Russian Soyuz and Progress vehicles) for crew exchange and resupply (critical consumables on board will maintain the crew until spring 2004), hardware is in good shape, and some research continues.

The NASA culture includes contractors, and contractors are part of the solution. Because contractors do the actual work, they're doing a lot of the analysis. However, contractors need to assess their interactions with NASA. An independent technical authority has been suggested, which could result in an Agency change. A fundamental debate is the amount of authority and responsibility the program manager has, an issue that deals with culture change.

Necessary actions to return to flight include: ET foam shedding in four areas is being examined. LO_2 feedline bellows are being redesigned to prevent ice build-up. The on-orbit inspection process is already loaded, and training has begun on how to use the system to repair wiring and tile. A complete survey for inspection and repair with the arm with extension boom and camera takes nearly 8 hours.

Launch schedule is under review, but will be no earlier than September 12 to October 10, 2004. The mission has been renamed STS-114 – LF1, and STS-121 – ULF1.1 has been added. Launch restrictions include having more camera views available in different positions on ascent and having daylight conditions through ET separation. Neither can launch take place during a beta thermal constraint. Therefore, the launch window following October 10 is three days in November.

Orbiter 103 is going through routine maintenance; 104 is planned to be the return-to-flight orbiter. Orbiter 105 (Endeavor) is in maintenance (to maximize the time the fleet was grounded) and will be ready in June 2005.

In sum, NASA accepts the Columbia Board findings, will comply with the recommendations, and embraces the report. NASA will "raise the bar" and complete other actions deemed necessary to

ensure a safe return to flight. The return-to-flight process is deliberate and cautious. The Space Shuttle three-orbiter fleet supports continuing ISS assembly and operation.

Discussion

- The Engineering and Safety Center, members of which have a great deal of specific technical expertise, will begin operations November 1, with a high-priority focus on return to flight. The intention is that this center will have the capacity to do independent testing and analysis. They'll provide a resource and independent review, although the independent technical authority concept is still under discussion. How this center and the other NASA groups will interrelate is under discussion.
- To change culture, you first have to agree that an issue needs to be addressed. Every NASA employee will get a copy of the CAIB report and will be encouraged to read it and discuss what it means for everyone. All employees must buy into the process, and they all do seem to be taking it seriously. NASA can't effect culture change by itself, and outside experts who have the right expertise are being considered.
- The Shuttle program's motto is "Find the problem, fix it, and return to safe flight," but we must add prevention and anticipation of problems.

2003 NASA Strategic Plan—Ms. Lisa Guerra

The BPR Enterprise Strategy is one of six NASA Enterprise Strategies. This year, outcomes must be related to the budget. (So far, BPR is the only enterprise to pull this together.) They looked at the interrelationship of all the questions and included a roadmap to each question. For each question they have a benchmark of where research is today, and what they plan to accomplish in 2004–2008 and 2009–2016.

- Question 1 (How can we assure survival of humans traveling far from Earth?) research focuses on: adaptation and countermeasures, radiation health, behavioral health and human performance, and medical care.
- Question 2 (How does life respond to gravity and space environments?) research focuses on: molecular and cellular impacts, life in space, ecosystems, and generations.
- Question 3 (What new opportunities can research bring to expand our understanding of the laws of nature and enrich lives on Earth?) research focuses on: physical and chemical processes, fundamental physics, biotechnology, and research partnerships.
- Question 4 (What technology must we create to enable the next explorers to go beyond where we have been?) research focuses on: advanced life support, research for engineering solutions, space human factors engineering, and advanced environmental monitoring and control.
- Question 5 (How can we educate and inspire the next generations to take the journey?) is not a research focus, but instead gives four priorities—to engage students, empower educators, engage audiences, and involve higher education.

They produced two documents: *Integrated Budget and Performance Document,* and *Performance and Accountability Report.* The strategy is also available at: <http://spaceresearch.nasa.gov/>. The document (7000 copies of the 3-year strategy) will be distributed to internal and external audiences. The new Agency strategic plan comes out in February 2006; enterprise strategies come out in fall 2006.

Discussion

- One advantage to the question approach is that it invokes the crosscutting interdisciplinary relationships NASA advocates, and is something we're wrestling with for the reorganization of the BPRAC.
- Next year (2004) BPR will decide whether the planning and documentation are effective. Great effort and expense went into publishing the strategic plans, so they will probably remain 3-year plans. Even putting out an update in February is a sensitive issue because things may change.
- Some of the language is obscure. BPR is considering using more of the scientists' language, but, on the other hand, the main audience is Congress.
- The BPR Enterprise did well to produce this in such a short time.

Subcommittees—Dr. Baldwin

CAS

- The CAB should not be ended yet.
- Overarching question #3 should be divided in two.
- Representatives from the commercial end should be represented on each enterprise.
- When considering the fate of the RPCs, NASA should recognize its statutory obligation to deal with commercial end.
- The SOW for the Space Utilization Advisory Committee lacks breadth; 50% engaged in research rather than institute support for ISS utilization as originally proposed.
- Elsa Porter is stepping down from CAS, having served for 6 years (two 3-year terms).

LSAS

- LSAS is much concerned about having cohesiveness regardless of how the infrastructure evolves, e.g., timely meetings.
- Scope of work.
- They want to be involved in strategic planning and in more public advocacy (including training to advocate effectively).
- They want to be briefed on: free flyers, evolution of NSBRI, and current thrust to have integration through FSB and Bioastronautics.
- They applaud science retreats and Howard Ross' work.
- They have considered the expertise needed for membership in committees and subcommittees.

Review of Issues, Findings, and Recommendations

OBPR Status

The BRAC congratulates OBPR for aggressively putting its administrative infrastructure in place, responding to the various task force reports designed to transform operations with the enterprise generating a visionary strategic plan, and making significant accomplishments in its research mission and planning its research strategies. This has occurred during a period of discomfort and operational stress given the tremendous interference with OBPR operations in dealing with the consequences of the Columbia tragedy.

The BPRAC commends Dr. Frank Schowengerdt for his constructive efforts to realign the programs of the Research Partnership Centers to meet the dual needs of NASA and industry.

The BPRAC fully supports the operations and achievements of each of the divisions within OBPR and remains postured to closely work with the enterprise as it continues to carry out its mission.

BPRAC Subcommittee Restructuring

Finding

With the restructuring of OBPR strategy and definition of overarching themes, reorganization of BPRAC advisory strategy, including subcommittee structure, also must be considered. The Committee observes that considerable overlap exists in content among the OBPR themes. The Committee is concerned that a rigid advisory subcommittee structure may foster parochial responses to issues related to these themes. In responding to these strategic issues, benefit may accrue from multidiscipline advisory task forces, comprising BPRAC members and ad hoc appointees to supply specific expertise, that could be charged for limited periods and extended or reformed as strategic exigencies vary. With this construct, BPRAC, itself, would act as the integrating body, receiving the task force reports and submitting recommendations to OBPR. At the same time, certain specific ongoing responsibilities of OBPR (e.g., liaison with the commercial community, interaction with other codes in development and utilization of ISS) require very specific expertise and focus, and can be projected as ongoing needs throughout the life of the current strategic plan. For these purposes, ongoing subcommittees may remain appropriate. In addition, the specific reporting structure of these subcommittees may require reconsideration, to maximize benefit to NASA from their views. Finally, the Committee is cognizant that the Advisory structure must avoid unwieldiness and excessive consumption of resources (time, travel money) and must maintain sufficient flexibility to respond quickly to the changing needs of OBPR as they are perceived.

Recommendation

1. SSUAS should continue as a formal subcommittee. It should report formally not only to BPRAC and OBPR, but also to the other codes involved in construction and maintenance of ISS. Consideration should be given to providing for direct reporting by SSUAS to NAC.
2. TAS should continue as a formal subcommittee, though it may be useful to add some additional members who do not directly represent the commercial community.
3. Advisory functions for research issues (Bioastronautics and Fundamental Space Biology, benefits to the home planet, education) should be subserved by task forces.
4. BPRAC have examined the two principal alternatives for subcommittee organization given the refocus of the Office of Biological and Physical Research:

   A) Management Focus: Division-focused providing oversight and advisory relationship to program divisions. Strategy development could be conducted through the formation of an individual task force based on the overarching enterprise strategies. The tasks forces would be comprised of members of the existing subcommittees. (Figure 1)

   1. Commercial (Space Product Development)
   2. Life Sciences (Biastronautics & Fundamental Space Biology)
   3. Physical Sciences
   4. Space Station Utilization

   Cons: Complicated organization structure, multiple lines communication and reports.

B) Strategy Focus: Effectively supports strategy development and represents the primary functions through ad hoc task forces. The subcommittees would be replaced by the task forces specifically created to support the overarching strategies. This would ensure that there is effective integration of the division support by the BPRAC committee members. (Figure 2)

1. How can we assure the survival of humans traveling far from earth?
2. How does life respond to gravity and space environments?
3. What new opportunities can our research bring to expand our understanding of the laws of nature and enrich lives on Earth?
4. What technology must we create to enable the next explorers to go beyond where we have been?

Cons: Limits BPRAC relationship to individual program divisions.

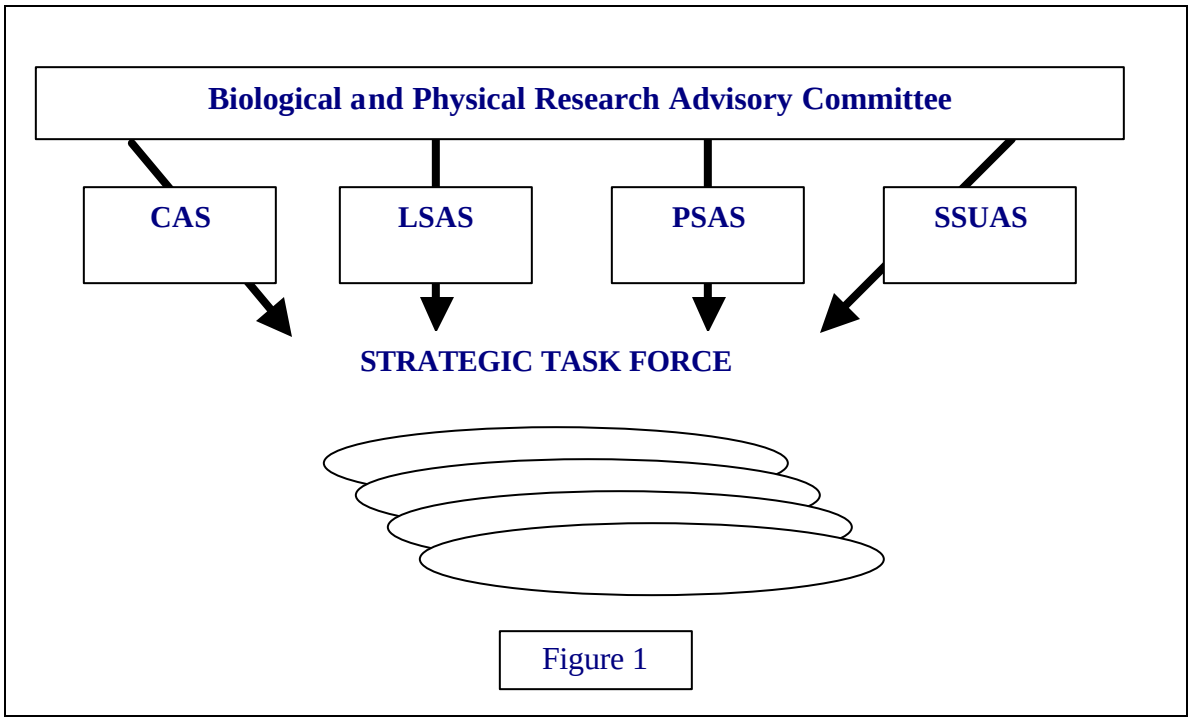

Figure 1

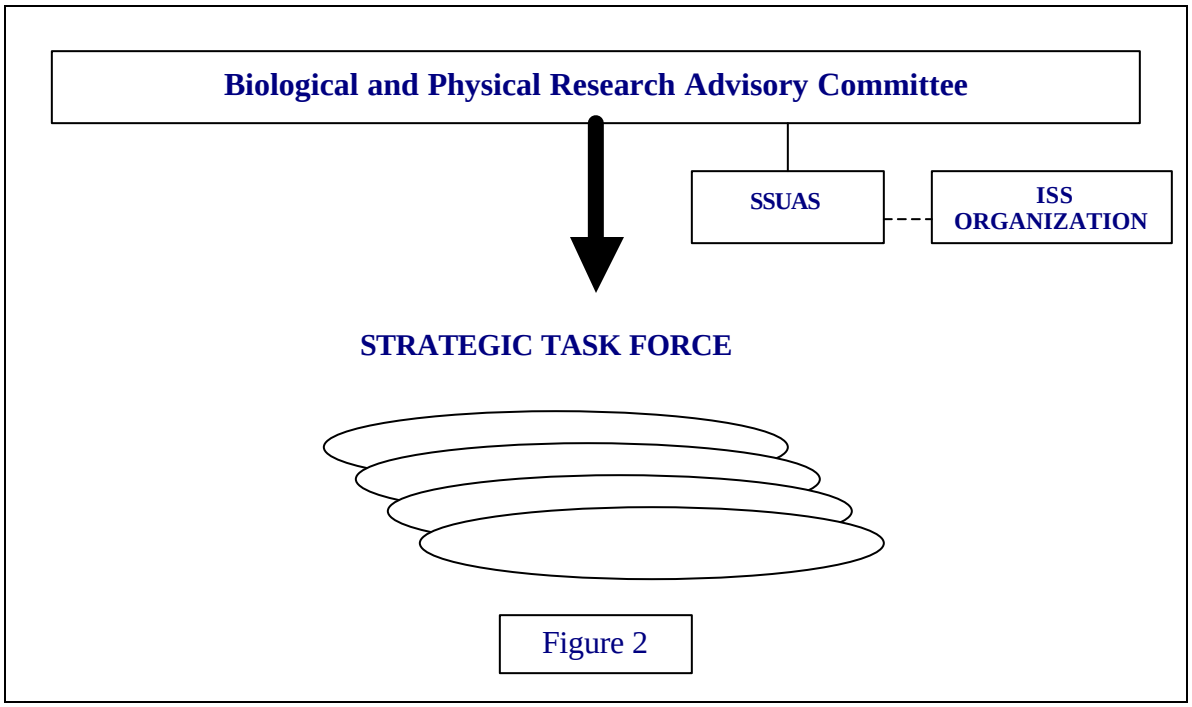

Figure 2

ISS Research Institute (ISSRI)

Findings

The committee was briefed on progress toward developing the non-government organization (NGO), that will be tasked with managing ISS utilization, and will be called the ISS Research Institute (ISSRI), and progress toward developing a detailed statement of work (SOW) for ISSRI that was released for comment on September 9, 2003. This document makes significant progress toward addressing the February BPRAC recommendation: "NASA still needs to articulate more clearly the division of research management between OBPR and the proposed ISS-NGO as well as with other research institutes involved with OBPR. The manner in which NASA Headquarters intends to handle the NRA and grant selection processes for the ground-based and flight research is a particular concern." Nevertheless, there still are two areas of concern about handling NRA and grant selection processes, as follows:

1. With respect to OBPR principal investigator (PI) solicitation and selection, current plans involve significant formal involvement of the ISSRI in development of NRAs, the selection of panel members and with developing recommendations for PI selection.
2. With respect to OBPR guest investigator (GI) solicitation and selection, current plans involved control of these processes by the ISSRI, with only an advisory role for NASA Headquarters. BPRAC feels that these two approaches taken in the SOW tend to leave the impression that there are potential conflicts of interest in the solicitation and selection of PIs

and GIs, and we are concerned that the proposed approach could lead to criticism of OBPR's research quality in the future.

3. Under the current plans the professional staff of the ISSRI would spend 50% of their time doing independent research, whereas they should spend all of their time preparing flight experiments for execution on the ISS.

Recommendation

BPRAC would welcome an opportunity to enter into timely discussions with OBPR concerning solicitation and selection of PIs and GIs and any other issues pertinent to the successful operation of the NGO, in order to find improved ways that avoid our concerns about the current plans for the ISSRI SOW. This could be achieved by assembling a task force involving current members of the BPRAC. (including concerning the need for this institute)

Activities within OBPR

Finding

Both the various subcommittees and BPRAC were pleased with the breadth and depth of the numerous activities ongoing within all divisions of OBPR and the leadership provided by the division directors.

Recommendation

In order to remain abreast of these activities, the BPRAC and its subcommittees request periodic briefings on the following topics: free flyer operations; the evolution of the NSBRI; the integration of biomedical research (including BR&C, FSB, and physical sciences) to produce countermeasures; the status of those programs addressing space explorations.

TAS

Finding

The planned closing of several Research Partnership Centers through projected budget reductions in FY05 and beyond will result in the loss of a highly productive collaboration by NASA with industry and academia in developing the economic benefits of space. These research partnerships have proved to be a valuable asset to NASA and the Nation and fulfills NASA's statutory requirement to "promote" the economic development of Earth orbital space" (the Commercial Space Act of 1997). The centers now generate a 3-to-1 ratio of non-SPD funding to SPD funding.

Recommendation

The proposed elimination of RPCs should be reconsidered, in order to prevent the loss of this valuable resource to NASA.

Cost of Hardware Development

Finding

Significant cost differentials now appear to exist between the cost of hardware produced through NASA centers and the cost of hardware produced by Research Partnership Centers. Much of the discussion about these differences is anecdotal. It lacks factual and analytical understanding of the drivers of hardware cost and ways that the costs can be more effectively managed.

Recommendation

OBPR should undertake a study of the drivers of hardware costs comparing various developers (RPCs, NASA Centers, etc.).

Appendix
Agenda

Thursday – October 23

9:00 AM	Welcome/Chair's Review of Agenda/Logistics	Dr. Baldwin
9:10 AM	OBPR Program Overview	Ms. Kicza
11:00 AM	BPRAC Subcommittee Structure	Dr. Carpenter
12:00 PM	Lunch (Research presentation by Alex McPherson)	
1:00 PM	ISSRI Update	Ms. Park
2:00 PM	NASA Budget Perspective	Mr. Isakowitz
3:00 PM	Division Directors' Reports	
	Mission Integration	Mr. Ahlf
	Space Product Development	Dr. Schowengerdt
	Physical Sciences Research	Dr. Trinh
	Bioastronautics Research	Dr. Barnes
	Fundamental Space Biology	Dr. Lomax
6:00 PM	Adjourn	

Friday – October 24

8:00 AM	NASA's Plans to Return to Flight	Ms. Cline
9:00 AM	2003 NASA Strategic Plan	Ms. Guerra
10:00 AM	International Space Station Research Status	Dr. Thomas
11:00 AM	Review of Issues, Findings, and Recommendations	Dr. Baldwin
12:00 PM	Adjourn	

Life Science Advisory Subcommittee Findings and Recommendations

1. Regularly scheduled meetings twice a year (need not be dependent upon the BPRAC); quarterly supporting telecon working sessions and when issues come up.

2. Training for advocacy.

3. Term should extend at least 3 years, preferably 5 and be renewable.

4. LSAS alumni form a working group for current LSAS.

5. *Scope of work for LSAS
   - Strategic planning for life sciences research with 10-year horizon, dependent on flight opportunities and NASA goals
   - True program assessments
   - Public advocacy

6. Requests for briefings:
   - Free flyers
   - NSBRI evolution
   - Integration of biomedical research (including BR&C, FSB, and physical sciences) to produce countermeasures
   - What we need to know if we go to Mars in 10 years—environment and contaminants, biological implications

7. *LSAS applauds the incredible effort of SSUR. At each meeting there should be a progress report on the 8 priority change strategies SSUR identified. A "pulse" survey could be given regularly to the user community to gauge progress in the SSUR.

8. *Several fundamental concerns regarding the NGO Statement of Work will be drafted within 10 days.

9. *The Subcommittee applauds the success of integration across disciplines. Examples of this are that radiation health is working across Code U; the forthcoming plant workshop bringing together researchers from AHST and FSB; and the Code U science retreat organized by Howard Ross.

Current LSAS Members & Expertise

Name	LSAS Discipline Area	LSAS Perspective	Future with LSAS?
Joseph Furman	MD/PhD neurologist Vestibular/balance system Clinical research		Continue
Bernard Harris	Former astronaut Physician Entrepreneur/business		?
Walter Hill	Advanced life support Life sciences education	NASA URC PI	Continue either as a member or as an alum
Harry Janes	Plant biology and biochemistry and ALS	NASA PI	Continue

Amy Kronenberg	Radiation health Cell and molecular biology	NASA ground PI	Continue until a successor can be found with some transition
Mike Katovich	Animal physiology	Centrifuge science working group at NASA AMES "rodent"	Continue
Marlene MacLeish	Education/Outreach FORNSBRI		Continue
Mary Musgrave	Plant biology Advanced life support	NASA flight PI NASA ground PI	Stay on until a successor is found
Jim Pawelczyk	Former astronaut Cardiovascular physiology	Ground PI Flight investigator	Continue
Jack Stuster	Behavioral sciences, habitability Space human factors	NASA ground PI NASA flight PI	Continue
Herman Vandenburgh	Muscle physiology and biochemistry	NASA flight PI NASA ground PI	Continue

Desired Membership Characteristics for LSAS

Needed Expertise	**Perspectives & Qualities**
Cell & molecular biology	Commitment
Developmental biology	Motivation
Organismal biology	Forward looking
Clinical & operational medicine	Team players; enablers
Radiation	Communication skills
Behavior & performance	Investigators funded by NASA & investigators not funded by NASA
Neuroscience	Breadth of institutional representation—laboratories, university, industry, NSBRI, etc.
Pharmacology	
Technology [in situ measurement, sensors, telemetry, imaging]	
Advanced life support	
Microbiology	
Bioinformatics	
Physiology	
Nutrition	
Education & outreach	
Human factors engineering	

Material Presented at the Meeting

Status of BPRAC Recommendations—Dr. Carpenter
BPRAC Organization Issues—Dr. Carpenter
International Space Station (ISS) Research—Dr. Thomas
ISS Research Institute—Ms. Park
Mission Integration Division—Mr. Ahlf
Space Product Development (SPD)—Dr. Schowengerdt
Physical Sciences Research Division—Dr. Trinh
Status of NASA Bioastronautics Research Division—Dr. Barnes
Fundamental Space Biology Division—Dr. Lomax
Return to Flight: NASA's Response to the CAIB Report—Ms. Cline
Biological and Physical Research Enterprise Strategy—Ms. Guerra
The Structures of Life—Dr. McPherson

Persons Present at the Meeting
October 23, 2003

NASA
John-David Bartoe
Brad Carpenter
Mark Nall
Sherwood H. Anderson
Ed Smylie
Michael J. Wargo
David B. Jarrett
Merrill King
Don Thomas
John Emond
Roger Crouch
Terri Lomax
Orlando Santos
Volker Kern
Candace Livingston
Stephen McGinley
Donna Shortz
Gene Trinh
Peter Ahlf
Elizabeth Gonzalez
David J. Faisens, Jr.
Charley Barnes
David Tomko
R. C. Zwierko
Gib Kirkham

non-NASA
Ken Baldwin
Alex McPherson
Jeffrey S. Borer
Bernard Harris
Leroy P. Gross
Raymond Bula
Chris Shank
Nick Bigelow
G. M. Faeth
Mary Musgrave
Tom Daley
Elsa Porter
Russ T Jargos
Jay Sanders
Patricia Russell

October 24
NASA
John-David Bartoe
Howard Ross
Brad Carpenter
Volker Kern
Elilzabeth González
Orlando Santos
Candace Livingston

non-NASA
G. M. Faeth
K. M. Baldwin
Jeffrey S. Borer
Jay H. Sanders
Elsa Porter
R. J. Bula
Patricia Russell
Michael Gan
Chris Shank
Alex McPherson

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